COMPLETE EDUCATIONAL MODULE

TITLE:
Renewable Energy: Let's Get Cookin'

AUTHOR:
Diedra Vinson

GRADE LEVEL/SUBJECT:
4th Grade/Science
Two, 45-60 minute periods (2)
Third day of instruction will vary

NATIONAL SCIENCE EDUCATION STANDARDS:

Content Standards: K-4

CONTENT STANDARD A:
As a result of activities in grades K-4, all students should develop

- **Abilities necessary to do scientific inquiry**
- **Understanding about scientific inquiry**

CONTENT STANDARD B:
As a result of the activities in grades K-4, all students should develop an understanding of

- **Properties of objects and materials**
- **Position and motion of objects**
- **Light, heat, electricity, and magnetism**

CONTENT STANDARD D:
As a result of their activities in grades K-4, all students should develop an understanding of

- **Objects in the sky (Sun)**

CONTENT STANDARD E:
As a result of activities in grades K-4, all students should develop

- **Abilities of technological design**
- **Understanding about science and technology**
- **Abilities to distinguish between natural objects and objects made by humans**

CONTENT STANDARD F:
As a result of activities in grades K-4, all students should develop understanding of

- **Characteristics and changes in populations**
- **Types of resources**
- **Changes in environments**
- **Science and technology in local challenges**

CONTENT STANDARD G:
As a result of activities in grades K-4, all students should develop understanding of

- **Science as a human endeavor**

OVERVIEW:

The essential question to be answered is: Are we using our resources to generate energy/electricity in the most efficient, clean and responsible manner both domestically and internationally?

This lesson is one small segment of a unit on Energy/Renewable Energy. This unit can integrate math, science, geology, history, language arts, and social studies. Included are helpful websites to support the material presented here. This lesson will teach students how light will reflect off of a parabola and how the sun, our main source of light and energy can be utilized to cook food in a parabolic cooker without the use of electricity or fossil fuels. The importance, or the overall message of this unit should be clean renewable energy, amount of pollution, fossil fuel use, and how we can become better consumers of our available resources. Teaching a unit about renewable energy and how it is applied to life outside the classroom will give students an experience that will instill lifelong learning. In addition, the students will learn about our dependence on fossil fuels, global warming, regions of the world, and where a particular renewable energy technology applies and why. The theme of renewable energy will allow the students to apply all subject knowledge and the students will be able to associate different parts to make a whole. The students will learn about the global community and how our actions affect their future.

PURPOSE OF LESSON:

The purpose of this lesson is to help students understand:

- How light is reflected
- How to find a focal point on the hot dog cooker
- How to reflect light to create concentrated energy
- How to use this concentrated energy to cook food
- How renewable energy can replace our current use of fossil fuels with a clean resource that will cut down on pollution and emissions
- How current research is applied to life outside the classroom
- Where this technology is most applicable in the world
- How developing countries are using the energy from the sun for everyday needs without using nonrenewable energy sources.

LEARNING OBJECTIVES:

- Students will learn how everyday objects are used for science
- Students will learn how to observe and describe properties of materials
- Students will learn how light reflects on curved surfaces
- Students will learn how to construct a solar cooker using their knowledge about parabolic shapes
- Students will learn how to prepare food in a solar cooker
- Students will learn where solar energy works best.

VOCABULARY: The terminology listed below should be used throughout the lesson

Parabola/Parabolic Shapes
Sunbelt
Reflection
Focus/Focal point
Axis of symmetry

RESOURCES/MATERIALS:

Mirrors
Flashlights
Overhead projector
Masking tape
Supplies for hotdog cookers
Drinking glass

Included are the materials for a variety of projects. It is up to the educator depending on time what to use and the knowledge of the students.

Supplies and instructions for cookers below at the following web sites:

- SIMPLE HOT DOG COOKER (PARABOLIC COOKER)
  http://www.energyquest.ca.gov/projects/solardogs.html
- PRINGLE CAN PARABOLIC HOT DOG COOKER
  http://www.geocities.com/Heartland/Pointe/9385/pringle.htm
- "FANCY" PARABOLIC COOKER
  http://www.nrel.gov/business/education.html

OTHER SOLAR COOKERS:

- SOLAR OVEN: http://www.kaaplei.fi/~tep/man/manual.html This site has wonderful information on international use, history, and instructions for oven. I recommend the sites below for easier instructions for the oven.
- MINIMUMBOX COOKER
  http://www.thegreenguide.org/diy/solar.php
- PIZZA BOX OVEN
  http://www.solarnow.org/pizzabx.htm

HANDOUTS/Teacher Reference Sheets and Diagrams:

Rubric
KWL Chart
Picture of "Human" Parabola
Diagram of Light Reflecting on a Parabola

PREPARATORY ACTIVITIES: *There is an abundance of information to help the instructor and students understand solar energy. The National Renewable Energy Laboratory (NREL) is the primary source for information.*

ADDITIONAL RESOURCES:

- This site has other solar projects and a glossary of terms
  http://www.nrel.gov/education/pdfs/sciproj.pdf
- FACT SHEETS AND INFO
  http://www.solarovens.org/need.html
  http://www.cc.jyu.fi/~hvirtane/chin6.html
  http://www.sunoven.com/sunoven.htM

At this point students should know and understand:

- **How to follow safety procedures when performing science experiments**
- **The difference between nonrenewable and renewable energy sources**

- **Sun facts and misconceptions/why we have seasons http://alpha.fsec.ucf.edu/ed/solar-unit/track-shadows/sunmiscon-teachinfo.htm**
- **What the sunbelt is and why it is important for solar energy**
- **Global Warming**

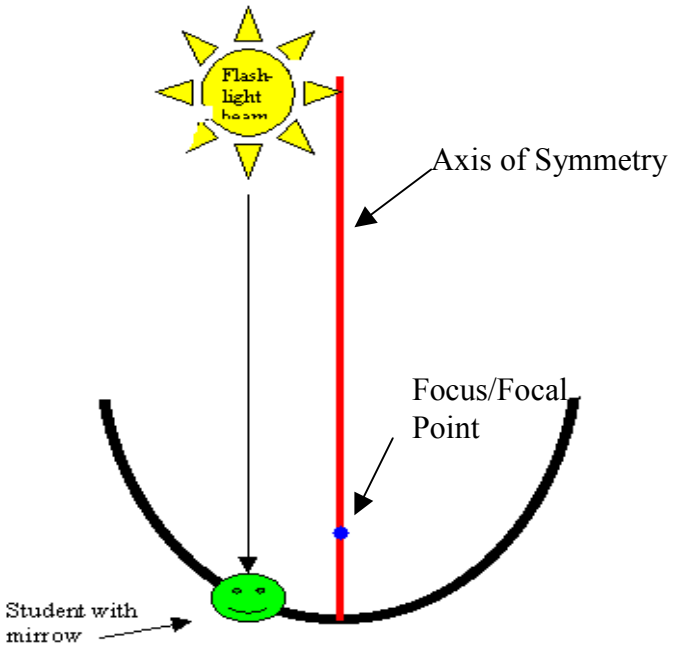
- **Population growth**
- **Fuel sources**

The teacher should build a "fancy trough" prior to instruction to demonstrate this simple but fascinating technology during the construction of their parabolic troughs. I built one for my classroom and it took around 30-45 minutes.

MAIN ACTIVITIES:

Day 1
45-60 minutes
Students should be in groups of three

- Before lesson tape a parabola on the floor with the axis of symmetry

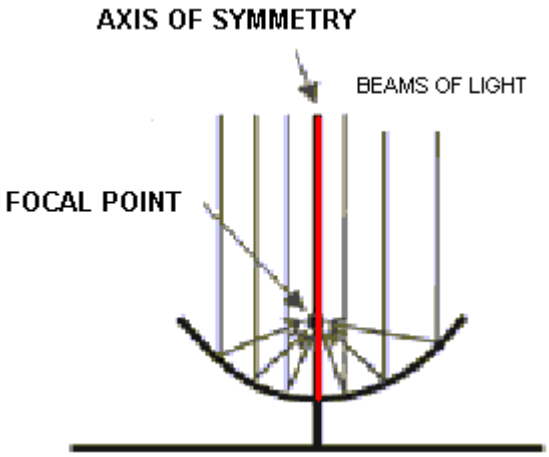


The above diagram shows where the 3 students should stand.

- Have one student stand on the parabola holding a mirror
- Have another student directly in front of the mirror with a flashlight.
- The third student should be on the line of symmetry.
- Point flashlight towards mirror
- Turn off the lights
- Watch what happens
- The student with the mirror will have to adjust the position of the mirror to reflect the light on the student standing on the line of symmetry at the focal point
- When all of the teams have successfully focused the light on the line of symmetry have all the students stand shoulder to shoulder on the parabola holding a mirror
- See picture below of “Human Parabola”
- Use the over head projector as your light source or flashlights if you have enough
- Then place a glass on the line of symmetry
- Have the students adjust their mirrors to have the light reflect toward the glass. The challenge is to see if the whole class can work together to find the focal point.
- This is a good visual to show how light is absorbed and emitted.
- Perform KWL
    - Break into same groups of 3 and have each group brainstorm about what they know about a parabolic shape. You may have to give them an example to stimulate their thinking (satellite dish)
    - Have a member from each group tell what they know and record these responses on whole class KWL
    - Write all responses in the first column (KWL chart).
    - The last column will confirm the information in the first column at the end of the lesson

Pictured below is a diagram and picture for the group to perform this lesson.

Diagram of light reflecting on the parabola to a focal point. Remember that the light beams must reflect on the parabola parallel to the axis of symmetry. This diagram shows where the students should be standing for the group activity.



HUMAN PARABOLA

Picture of NREL interns demonstrating the parabola
Left: Flashlights are parallel to the axis of symmetry. On the opposite side interns are holding their mirrors on the parabola and the light is reflecting to the focal point which is the water bottle.

Right: This picture was taken without a flash. The spec of light in the center is the focal point. This effect is much brighter in real life.

Wrap Up Day 1

- Summarize what the students have learned on the KWL
- Inform the students that with the knowledge they have now they can find the focus point for the parabolic trough they are going to cook a hotdog. (The instructions for the various cookers show how to find the focus point)

Day 2

45-60 minutes to construct parabolic cookers

- The class can be grouped individually or in pairs to make the parabolic cookers.
- During this time check for understanding and discuss the process and concept of parabolic cookers

Day 3

Time will vary

- Follow the instructions for the cookers. Cooking time will vary depending on the weather.
- While the hot dogs are cooking show a map of the world and explain where these types of cookers are best utilized. (Sunbelt)
- Explain that the primary fuel for cooking is wood in many developing countries.
- Many forests are being cut down and disappearing forests contributes to global warming.
- Have the students write in their journal what they have learned about the energy of the sun and how it can produce clean energy.
- Complete and discuss KWL
- Eat hot dogs and clean up

Alternative to a class cookout

A solar cooking day can be organized to include the whole school and parents. This would give the students would the opportunity to demonstrate the renewable technology they have learned about.

RUBRIC: Let's Get Cookin'

Score	1	2	3	4	5
Team work/KWL Chart	Did not contributed to group effort	Very limited contribution to discussion and rarely listened to peers or offered any ideas	Occasionally contributed to discussion and listened once in a while to peers for best example	Contributed to discussion and generally listened to peers for best example	Contributed to discussion and listened to peers for the best example
Focus point	Student did not find focus point	Student had difficulty finding the focal point	Student could find focal point and could somewhat explain concept of reflecting light	Student could find focal point and could generally explain the reflection of light	Student could find focus point and could accurately explain the reflection of light
Solar hot dog cooker	Did not complete a hot dog cooker	Made a hot dog cooker but did not follow directions completely	Made a hot dog cooker but focus point was incorrect	Made a well built hot dog cooker with a very close focus point	Made and exceptional hot dog cooker with correct focus point

KWL Chart Group_____

What I KNOW	What I Want to Know	What I Learned